FEATURE 21: WESTERN RED RIVER VALLEY PIPELINE

Description

This feature has been developed as a pipeline supply to all major water user shortages. This feature uses the Missouri River as its water supply and is therefore a water supply import. In contrast to other features using import water, Feature 21 does not use the surface water system for any of its deliveries. A biota treatment plant is provide in the Missouri basin drainage and the water supply is then piped throughout the Red River Valley. The delivery pipeline is sized to meet Reclamation demand shortages estimated for the year 2050.

A pipeline transmission system would convey water from the end of the existing New Rockford Canal to various cities, new industries, and rural water districts along in the Red River Valley. The pipeline was sized for the maximum flow rates needed to meet maximum month shortages. These maximum rates were based on hydrologic analysis results for maximum drought demand. An operational minimum use was assumed to be half of the estimated maximum demand. A sketched layout is shown on the following figure.

The initial pipeline reach, starting at the New Rockford Canal, would have the pressure boosted approximately 400 feet by a pumping plant. The initial alinement proceeds 54.7 miles east to an elevated tank. This tank is estimated at about 500,000 gallons size at 160 feet high. This tank height may not be entirely practical, however, for this appraisal estimate it provides adequate results. A tee after the tank separately conveys about 123 cfs of water to the central and southeastern delivery locations. After the tee, the pipe continues east and a northern branch serves the northeastern portion of the state. About 18 cfs goes to the northern part of North Dakota.

Hydraulic analyses were based on Scobey's friction loss formula. Hydraulic losses were computed for friction losses only. Minor losses for bends, curves, tees, and tapers were not computed. These minor losses would be expected to be a small percentage (about 5 %) and therefore would not be expected to affect the overall layout with significant costs. Hydraulic analysis results are shown on a spreadsheet.

Proposed pipe routes roughly follow existing roads and county lines. These routes were based on a state highway map and would need to be checked in the field. About 600 miles of pipe would be placed. Construction cost estimates are based on using B cover class pipe. Elevated tanks were placed to minimize the pipe pressure classes. Hydraulic transients effects have not been calculated for the pipe reaches. Pressure classes per pipe reach were estimated for the average pressure along the profile.

The hydraulic analyses checked to see if the ending head equaled or exceeded the delivery ground surface elevation. Positive values mean excess head remains. Pipe reaches were analyzed with only one pipe size per reach. Where excess head exists, especially for a single delivery after a tee,

downsizing pipe would be possible. If the head was close to the delivery ground elevation, this was assumed close enough at this study level.

An example of potential pipe downsizing would be at the tee to the Grand Forks new industry. Using only 21-inch diameter pipe results in about 273 feet of excess head. However, if 18-inch pipe were used, the end head would be short about 150 feet. Therefore this reach would be sized in refined analyses to use a combination of 21- and 18-inch diameter pipe.

Three elevated tanks were tentatively placed on the north branch and two elevated water tanks were placed on the south branch. The operating water surfaces were based on the hydraulic grade line for maximum flow. At flows less than maximum, pressure reducing valves would dissipate excess energy to the tanks. These valves would have to be controlled to shut off at a high tank level. The number and sizes of valves in each pit are listed on the valve pit worksheet.

Three pumping plants were placed on the tentative layout. The first pumping plant is at the New Rockford canal. Two other pumping plants were needed for the extreme northern deliveries. One plant would be dedicated for the Langdon delivery and the other plant would be located downstream of Grafton. The Grafton pumping plant would furnish sufficient head to deliver water to Pembina.

Pumping plant data is: New Rockford Canal plant, 142 cfs at 400 feet head; an inline booster for Langdon, 0.34 cfs at 655 feet; and an inline booster after Grafton, 1.3 cfs at 340 feet.

Annual power costs for pumping at the above plants are estimated on the cost worksheet.

Worksheet attachments

Sheet Number	Description
1	Delivery flows and locations
2	Pipe hydraulics and tank sizes
3	Pressure reducing valve pit data
4	Power cost estimates

Feature 21 - Western Red River Valley Pipeline System

Pipe intake elevation at New Rockford canal terminus:	480	1575
	meters	feet

Water supplied by pipeline to the following locations:

Location, water delivery	T-R-S (township-range -section)	Q in cfs	Elevation meters	Elevation feet
MUNICIPAL:				
Fargo	140-49-27	57.1	275	902
W. Fargo	140-49-27	7.2	275	902
Moorehead	140-49-27	13.2	275	902
Drayton	159-51-27	1.1	244	800
Grafton	157-53-24	1.8	253	830
Lisbon	134-56-1	0.5	360	1181
Pembina	163-51-8	0.2	240	787
Valley City	140-58-11	1.8	425	1394
	Sum, major	82.9		
NEW INDUSTRY:				
Cargill, Wahpeton	132-48-1	9	293	961
New 2, Abercrombie	134-48-5	9	285	935
New 3, Fargo	140-49-27	9	275	902
New 4, N of Grand Forks	152-50-29	9	252	827
New 5, Lisbon(or Kindred)	134-56-1	9	360	1181
(if Kindred)	137-50-30		285	935
	Sum, new	45		
RURAL WATER SYSTEMS:				
Agassiz	154-55-23	0.084	330	1082
Cass	139-51-8	4.060	280	918
Dakota	148-59-25	1.470	440	1443
Grand Forks-Trail	154-54-10	4.310	340	1115
Langdon	160-58-17, se	0.540	490	1607
SE Water Users	133-51-31	1.430	325	1066
Trail County	145-53-29	0.107	337	1105
Tri-County	154-55-29	0.790	350	1148
Walsh	156-56-22	0.340	355	1164
Ransom-Sargeant	134-54-11	0.500	325	1066
	Sum, rural	13.631		
	TOTAL SUM	141.531		

Water Delivery Data **Sheet 1**

Pipeline Starting after Pumping Plant at New Rockford Canal

Head 1 (begin) EL ft	Pipe diam. Inches	Q cfs	Delivery cfs	Velocity fps	Length miles	Head Lost ft	Head 2 (end)	Booster ft	Delivery EL	HGL above ft	Elevated Tanks OWS	Approx. Tank Height, ft	Estimated Tank Size Gallons	Ave Pipe Pressure Class, ft
1975	72	141.534		5.01	54.7	252.1	1722.9		<- South		1723	160	500,000	300
(400 ft boost added at pipe beginning)									<- North					
1722.9	72	123.37	1.47	4.36	35.3	123.6	1599.4		1443	156.4				200
1599.4	4		0.11	1.26	37.9	472.2	1127.1		1105	22.1				500
1599.4	72	121.79		4.31	33.5	114.3	1485.1							300
1485.1	60	92.36	1.8	4.70	5.3	27.1	1458.0		1394	64.0	1458	65	500,000	300
1458.0	54	90.56		5.69	37.1	316.9	1141.1							500
1141.1	15		4.06	3.31	4.5	74.0	1067.0		918	149.0				600
1141.1	48		86.5	6.88	14.7	212.6	928.4		902	26.4				700
1485.1	42	29.43	9.5	3.06	54.7	184.6	1300.4		1181	119.4	1300	120	200,000	400
1300.4	33	19.93		3.36	10.6	58.2	1242.2							200
1242.2	6		0.5	2.55	2.6	79.6	1162.6		1066	96.6				200
1242.2	30	19.43		3.96	14.1	121.4	1120.9							200
1120.9	15		1.43	1.17	11.5	23.5	1097.4		1066	31.4				200
1120.9	27	18	9	2.26	19.4	62.3	1058.6		935	123.6				400
1058.6	27		9	2.26	19.4	62.3	996.3		960	36.3				500
		Sum	123.37		300.6									
1722.9	33	18.164		3.06	48.5	221.2	1501.8							200
1501.8	12		4.31	5.49	3.5	209.3	1292.4		1115	177.4				400
1501.8	27	13.854		3.48	7.9	60.1	1441.7				1440	150	100,000	300
1441.7	21		9	3.74	24.7	341.2	1100.4		827	273.4				600
1441.7	18	4.854	0.79	2.75	15.9	143.5	1298.1		1148	150.1				500
1298.1	18	4.064		2.30	3	19.0	1279.1							500
1279.1	3		0.084	1.71	1.8	59.2	1219.9		1082	137.9				500
1279.1	18	3.98	0.34	2.25	19.4	117.7	1161.4	655	1164	-2.6	1162	0	10,000	500
1816.4	18	3.64	0.54	2.06	40.6	206.1	1610.3		1607	3.3				400
1161.4	15	3.1	1.8	2.53	26.5	254.1	907.3	340	830	77.3	907	80	25,000	400
1247.3	10	1.3	1.1	2.38	21.1	299.0	948.3		800	148.3				400
948.3	6	0.2	0.2	1.02	30.9	151.4	796.8		787	9.8				400
		Sum	18.164		243.8									

Notes: Elevated tank operating water surface (OWS) based on hydraulic grade line at pipe reach end (head 2)
Tank locations may need to be moved to find high ground points
Only one pipe diameter has been used for each pipe reach
Pipe pressure class is an approximate average for the upstream reach

Pipeline Hydraulics **Sheet 2 - a**

Pipeline Starting after Pumping Plant at New Rockford Canal

Line segment	Head 1 (begin) EL ft	Pipe diam. Inches	Q cfs	Delivery cfs Max.	Half flow cfs	Velocity fps	Length miles	Head Lost ft	Head 2 (end)	Booster ft	Delivery EL	HGL above ft
E1, T,s	1786	72	70.767			2.50	54.7	63.0	1722.9		<- South	
	(400 ft boost added at pipe beginning)										<- North	
s1,dak	1722.9	72	61.685	1.47	0.735	2.18	35.3	30.9	1692.0		1443	249.0
s1,t,trl	1692.0	4		0.11	0.055	0.63	37.9	118.1	1573.9		1105	468.9
s2,t	1692.0	72	60.895			2.15	33.5	28.6	1663.4			
s2,ah,vc	1663.4	60	46.18	1.8	0.9	2.35	5.3	6.8	1656.6		1394	262.6
s2,ah,t	1656.6	54	45.28			2.85	37.1	79.2	1577.4			
s2,ah,t,cas	1577.4	15		4.06	2.03	1.65	4.5	18.5	1558.9		918	640.9
s2,ah,fm	1577.4	48		86.5	43.25	3.44	14.7	53.2	1524.3		902	622.3
s3,li	1663.4	42	14.715	9.5	4.75	1.53	54.7	46.2	1617.3		1181	436.3
s4	1617.3	33	9.965			1.68	10.6	14.5	1602.7			
s4,t,r-s	1602.7	6		0.5	0.25	1.27	2.6	19.9	1582.8		1066	516.8
s5	1602.7	30	9.715			1.98	14.1	30.3	1572.4			
s5,t,se	1572.4	15		1.43	0.715	0.58	11.5	5.9	1566.5		1066	500.5
s6,ab	1572.4	27	9	9	4.5	1.13	19.4	15.6	1556.8		935	621.8
s7,wa	1556.8	27		9	4.5	1.13	19.4	15.6	1541.2		960	581.2
			Sum	123.37	61.685		300.6					
N1	1722.9	33	9.082			1.53	48.5	55.3	1667.6			
N1,T,gf-t	1667.6	12		4.31	2.155	2.74	3.5	52.3	1615.3		1115	500.3
N2	1667.6	27	6.927			1.74	7.9	15.0	1652.6			
N2,T,gf	1652.6	21		9	4.5	1.87	24.7	85.3	1567.3		827	740.3
N3,tri	1652.6	18	2.427	0.79	0.395	1.37	15.9	35.9	1616.7		1148	468.7
N4	1616.7	18	2.032			1.15	3	4.7	1611.9			
N4,T,ag	1611.9	3		0.084	0.042	0.86	1.8	14.8	1597.1		1082	515.1
N5,wal	1611.9	18	1.99	0.34	0.17	1.13	19.4	29.4	1582.5	290	1164	418.5
N5,ah,lang	1872.5	18	1.82	0.54	0.27	1.03	40.6	51.5	1821.0		1607	214.0
N6,t,gr	1582.5	15	1.55	1.8	0.9	1.26	26.5	63.5	1519.0	0	830	689.0
N7,dr	1519.0	10	0.65	1.1	0.55	1.19	21.1	74.8	1444.2		800	644.2
N8,pm	1444.2	6	0.1	0.2	0.1	0.51	30.9	37.9	1406.4		787	619.4
			Sum	18.164	9.082		243.8					

Pipeline Hydraulics at Half Flow Sheet 2 - b

Wester Red River Valley Pipeline

Pressure reducing valve pits upstream of the elevated tanks.

Tank Location	Flow D/S cfs	Min Head ft	Max Head ft	Reducing Valves #	Bypass Butterfly Valves
Grand Forks	9	0	202	1@10"	2@8"
Walsh	0.54	0	420	2@2-1/2"	1@2"
Grafton	1.3	0	610	2@4"	1@3"
Valley City	90.56	0	210	3@16"	2@8"
				2@8"	
Lisbon	19.93	0	320	1@12"	2@8"
				1@8"	

For each PRV size shown above the following are needed per valve:

2 equal size valves (1 gate and 1 motor butterfly)
2 corporation valves, 1" size, with pipe to tank

For each pit, manifold the PRV and bypass filling valves
Bypass valves are needed to fill the downstream tank and pipe
Two bypass valves are shown at locations where excess head must be dissipated to alleviate cavitation

Minimum dissipated head is assumed as a completely open valve filling to the designed tank operating water surface

Maximum dissipated head is based on hydraulic grade lines at half flow

Sheet 3

Western Red River Valley Pipeline

Annual Operating Power Costs (quick estimate)

Water Horsepower equation

HP = (QxH)/6.17 Efficiency is assumed to be an average of 0.7 for pump and motor

1 HP = 0.746 Kw Cost per kw-hr, $ 0.04

Plant	Max Q	Min Q	Ave Q cfs	Max H	Min H	Ave H ft	Yearly Hours	Cost $
Canal	141.534	70.767	106.1505	400	210	352.5	8760	2,125,006
Langdon	0.54	0.27	0.405	655	290	563.75	8760	12,966
Grafton	1.8	0.9	1.35	340	0	255	8760	19,550

TOTAL annual cost estimate, $ = 2,157,522

For hydraulics, see calculation spreadsheets

Ave H = 3/4 of the difference, based on friction related to V*2
For min Q of 1/2 Max Q

Present worth value of the annual pumping costs

Factor = 14.02 Value, $ = 30,248,464

Sheet 4 **Pumping Power Cost Estimates**

CODE: D-8170

ESTIMATE WORKSHEET

SHEET OF

FEATURE: 26-Apr-99

FEATURE 21B
Western Red River Valley Pipeline
84 CFS

PROJECT:
Red River Valley Water Supply

DIVISION:

FILE:
J:\REDRIVER\RRORURAL.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT	LIFE	Annual Operation	Annual Maintenance	Annual Replacement	Annual Energy	TOTAL ANNUAL
		Pumping Plant @ New Rockford Canal (380'-84cfs)		1	LS	$7,400,000	$7,400,000	35+	$140,000	$51,000		$1,160,000	$1,351,000
		Surge Protection Chamber		1	LS	$700,000	$700,000	50+					
		Booster Pumping Plant @ Langdon (655'-0.54cfs)		1	LS	$150,000	$150,000	35+	$700	$500		$15,300	$16,500
		Surge Protection Chamber		1	LS	$20,000	$20,000	50+					
		Elevated Watertank (300,000 gallon, 160' high)		1	LS	$475,000	$475,000	50+					
		Elevated Watertank (300,000 gallon, 150' high)		1	LS	$450,000	$450,000	50+					
		Elevated Watertank (150,000 gallon, 150' high)		1	LS	$325,000	$325,000	50+					
		Elevated Watertank (200,000 gallon, 100' high)		1	LS	$275,000	$275,000	50+					
		Elevated Watertank (25,000 gallon, ground level)		1	LS	$50,000	$50,000	50+					
		Furnish and install pipe with earthwork & ROW costs											
		60B300		88.20	miles	$1,099,000	$96,931,800	50+			$69,100		$69,100
		60B200		35.30	miles	$1,099,000	$38,794,700	50+			$27,700		$27,700
		4B500	PVC	37.90	miles	$57,000	$2,160,300	50+			$1,500		$1,500
		36B300		5.30	miles	$501,000	$2,655,300	50+			$1,900		$1,900
		36B500		37.10	miles	$686,000	$25,450,600	50+			$18,100		$18,100
		12B600	PVC	4.50	miles	$178,000	$801,000	50+			$600		$600
		27B600		14.70	miles	$579,000	$8,511,300	50+			$6,100		$6,100
		42B400		54.70	miles	$785,000	$42,939,500	50+			$30,600		$30,600
		30B300		24.70	miles	$429,000	$10,596,300	50+			$7,600		$7,600
		6B300	PVC	2.60	miles	$63,000	$163,800	50+			$100		$100
		15B300	PVC	11.50	miles	$202,000	$2,323,000	50+			$1,700		$1,700
		24B500		38.80	miles	$412,000	$15,985,600	50+			$11,400		$11,400
		36B200		48.50	miles	$501,000	$24,298,500	50+			$17,300		$17,300
		15B400	PVC	44.10	miles	$202,000	$8,908,200	50+			$6,400		$6,400
		33B400		7.90	miles	$518,000	$4,092,200	50+			$2,900		$2,900
		30B500		24.70	miles	$509,000	$12,572,300	50+			$9,000		$9,000
		18B500	PVC	15.90	miles	$257,000	$4,086,300	50+			$2,900		$2,900
		18B200	PVC	22.40	miles	$230,000	$5,152,000	50+			$3,700		$3,700
		3B200	PVC	1.80	miles	$50,000	$90,000	50+			$100		$100
		12B400	PVC	26.50	miles	$162,000	$4,293,000	50+			$3,100		$3,100

QUANTITIES

BY J. Baysinger

DATE PREPARED

APPROVED

PRICES

BY RCC K. Copeland

DATE 4/26/99

CHECKED DLM 4/26/99

PRICE LEVEL Appraisal

CODE: D-8170

ESTIMATE WORKSHEET

SHEET OF

FEATURE: 26-Apr-99

FEATURE 21B
Western Red River Valley Pipeline
84 CFS

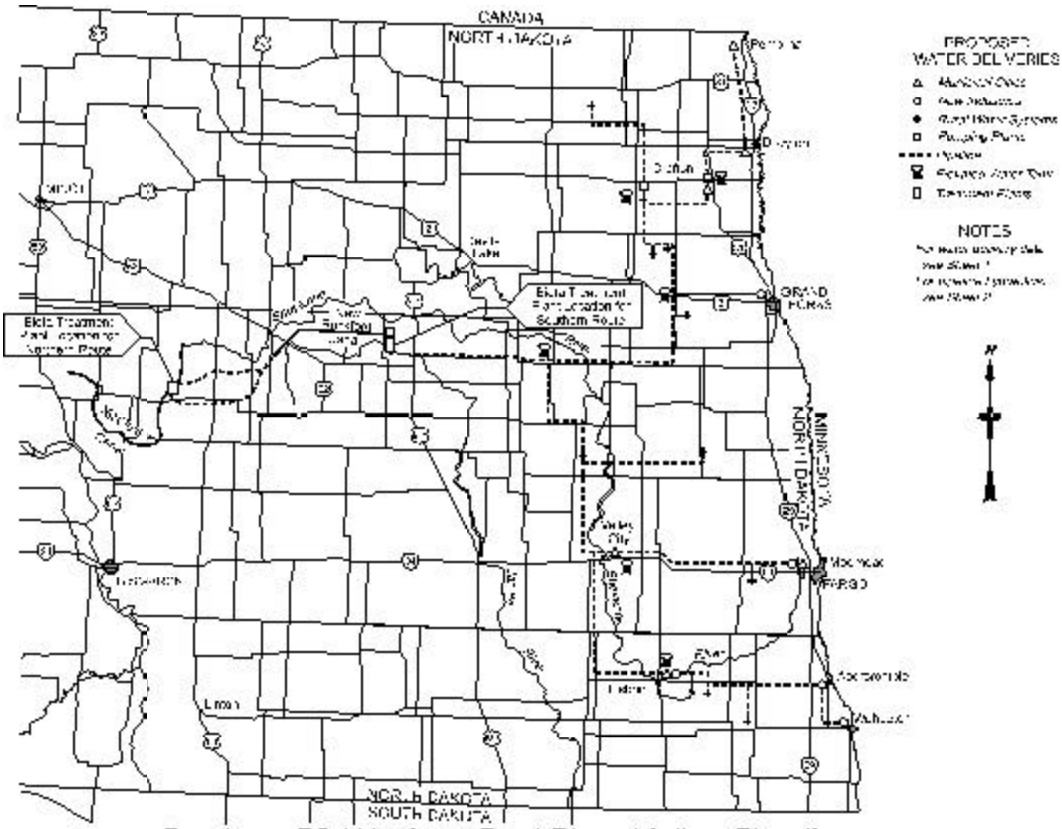
PROJECT: Red River Valley Water Supply

DIVISION:

FILE: J:\REDRIVER\RRORURAL.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT	LIFE	Annual Operation	Annual Maintenance	Annual Replacement	Annual Energy	TOTAL ANNUAL
		Air Valve Installations (2 per mile)		1,094	EA	$5,000	$5,470,000	50+					
		Blowoff Installations (2 per mile)		1,094	EA	$8,000	$8,752,000	50+					
		Cathodic protection for pipeline		379.9	miles	$26,400.00	$10,029,360	20			$937,700		$937,700
		Avg. Pipe Jacking (one per 4 miles, 54" carrier pipe	X 100')	137	EA	$70,000.00	$9,590,000	50+					
		Overhead powerlines for pumping plants		40	miles	$40,000.00	$1,600,000	45			$115,800		$115,800
		Telemetry System		1	LS	$3,200,000.00	$3,200,000	10			$226,600		$226,600
								Subtotal	$140,700	$51,500	$1,501,900	$1,175,300	$2,869,400
		Mobilization (+/- 5%)					$18,000,000				Unlisted Items (+/- 20%)		$570,600
		SUBTOTAL					$377,292,060						
		Unlisted Items (+/- 20%)					$72,707,940				**TOTAL O, M, R, & E**		**$3,440,000**
		CONTRACT COST					$450,000,000						
		Contingencies (+/- 25%)					$120,000,000						
		FIELD COST					$570,000,000						
		USBR Invest., Mitig., Engr. & Constr. Mgt. (+/- 33%)					$180,000,000						
		TOTAL ESTIMATE					**$750,000,000**				**ANNUALIZED CAPITAL COST**		**$53,480,000**
											TOTAL ANNUAL COST		**$56,920,000**

QUANTITIES		PRICES	
BY J. Baysinger		BY RKC K. Copeland	CHECKED DLM 4/26/99
DATE PREPARED	APPROVED	DATE 4/26/99	PRICE LEVEL Appraisal



Feature 21 Western Red River Valley Pipeline